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Coastal sediment and organic carbon flux to the Laptev and East Siberian Seas

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The coastal zone of the Arctic Seas is a place of dynamic interaction of the atmosphere, sea and permafrost. This zone of the Siberian Seas is known for active dynamics of erosive processes. Shore dynamics directly reflecting the complicated land-ocean interactions play an important role in the balance of sediments, organic carbon and nutrients in the Arctic basin.

Thermal abrasion is the most important destructive phenomenon in coastal retreat in that area. Among others the Laptev and East-Siberian Seas are of greatest interest. Due to erosion of their coasts a large volume of sediment and organic carbon is supplied to the sea. Based on the estimates of coastal sediment input and on the average organic carbon concentrations of the coastal sections, the total organic carbon supplied to the Laptev and East Siberian Seas by coastal erosion can be quantified as ca. 4 x 106 t/yr. Other European, Asian and American Arctic Seas are characterized by considerably lower coastal retreat rates, as well as lower sediment and organic input. The organic carbon, which originates from eroded coastal permafrost deposits, might be an important agent of increasing the greenhouse gas flux to the atmosphere.

The average retreat rates of studied shores were identified for both seas, including all their coastal segments. On the whole the rate of the Laptev and East Siberian coastal retreat is much faster in comparison with other Arctic Seas. During the last years a shoreline recession at the observed key sites, especially within the area of ice-rich permafrost, has significantly increased.

The Laptev and East Siberian coasts consist mainly of different types of Quaternary sediments including ice-rich deposits, which are characterized by extremely high ice contents, fine-grained texture, rapid coastal retreat (1 to 10 m/yr), and high concentrations of organic matter. In a number of coastal sections, the thermal abrasion cliffs are as high as 30-40 m and are predominately composed of polygonal ice wedges from the cliff foot to top (the so called Ice Complex).

During the last years, 49 key sections of the Laptev and East Siberian Sea coast were studied. The research program included the quantification of coastal retreat rates of representative key sections based on long-term field measurements, the analysis of the composition of the coastal sediments, which included the determination of ice content and specific density of the sediments, and the comparison of different-time topographic maps, satellite images and aerial photographs or a combination of both.